

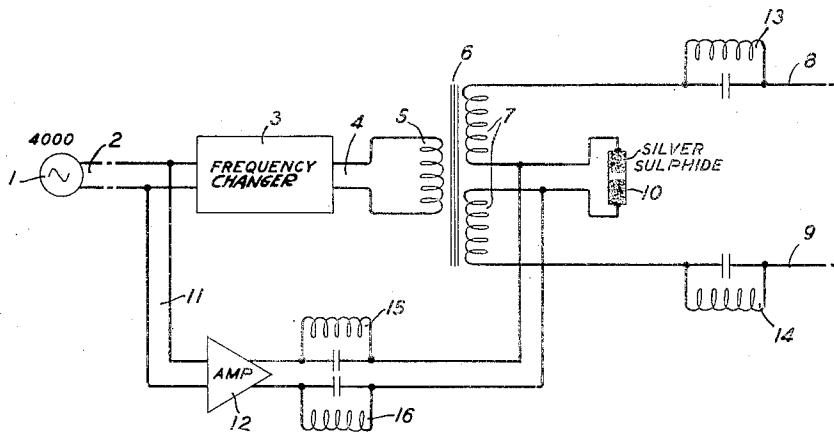
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SUPPLY CIRCUIT

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SUPPLY CIRCUIT

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This invention relates to a supply circuit controlled by a resistance element and particularly to a supply circuit controlled by a resistance element having a negative temperature coefficient of resistance and operating with a time lag.

One object of the invention is to provide a supply circuit having a resistance element with a negative temperature coefficient of resistance in circuit therewith that shall be governed according to heating of the resistance element by an alternating-current circuit directly connected to the resistance element.

Another object of the invention is to provide a circuit supplying a relatively low frequency current and having an element of silver sulphide in circuit therewith that shall be controlled by passing a relatively high frequency alternating current through the element of silver sulphide so that upon opening the high frequency circuit the low frequency circuit is blocked after a time delay.

A further object of the invention is to provide a standard frequency system having a relatively high frequency current reduced to a lower frequency current and supplied to a load circuit in circuit with an element of silver sulphide that shall directly heat the element of silver sulphide from the high frequency circuit so that upon failure of the high frequency current the load circuit is blocked.

In a system for supplying a standard frequency current to power companies or for supplying a constant frequency current to regulate clocks, it is often desirable to transmit the standard frequency current at a relatively high frequency and reduce the frequency before supplying the current to the customer. Usually the standard frequency current is transmitted at 4000 cycles and is supplied to the customer at 60 cycles, 100 cycles or other low frequency. The reduction from the 4000-cycle current to the lower frequency current is conveniently effected by means of the so-called multivibrator frequency converter. A frequency converter of the multivibrator type is shown in the patent to R. S. Ohl 1,765,606, June 24, 1930.

In a system of the above indicated type, trouble may be encountered in case of failure of the high frequency circuit, because the multivibrator continues to oscillate at its own frequency during the interruption. The frequency supplied by the multivibrator upon failure of the high frequency current usually varies only slightly from the standard low frequency current. In case of

brief interruptions of the high frequency circuit, which are known as "hits" and usually last only a small fraction of a second, the transmission to the customer of several cycles of a slightly incorrect frequency will cause little disturbance. However, if the incorrect frequency continues for an extended period of time, an appreciable error will take place in the operation of the apparatus controlled by the standard frequency current.

According to the invention, a 4000-cycle standard frequency current is transmitted from a standard frequency source to a distant point where conversion is made, preferably by a multivibrator to a low frequency standard frequency current. Preferably the low frequency current has a frequency of the order of 60 cycles per second. The low frequency current is connected through a transformer to a load circuit supplying standard frequency current to a power company or other user. In the load circuit is inserted a resistance element having a negative temperature coefficient of resistance. Preferably the resistance element is composed of silver sulphide but may be composed of other elements, for example, boron. The resistance element should decrease in resistance very rapidly as its temperature is increased and at the same time should not regain its high resistance instantly when the heating current is stopped.

In the illustrated system, a control circuit for heating the silver sulphide element in the load circuit is connected to the high frequency standard frequency system through an amplifier. The control circuit should be adjusted so that when the resistance element is heated thereby, the resistance of the element in the load circuit will only be a very few ohms. Furthermore, the resistance element should be constructed so that when the heating circuit is opened, as by failure of the high frequency supply circuit, the resistance in the load circuit will be sufficient to block the transmission of the low standard frequency current. Furthermore, if the heating current disappears for any reason, as by interruption of the high standard frequency circuit, a certain time interval should elapse before the resistance of the silver sulphide element increases sufficiently to block the load circuit. This circuit should be proportioned so that the output from the frequency converter is not sufficient to prevent the element of silver sulphide from cooling off when a high frequency heating current is interrupted.

A brief interruption of the 4000-cycle circuit will not permit the silver sulphide element to

cool off sufficiently to disconnect or block the load circuit. The circuit of the silver sulphide element will, of course, be designed so that ordinary line hits lasting one-tenth of a second or less will not sufficiently cool the silver sulphide element to block the load circuit. Upon blocking of the load circuit by failure of the 4000-cycle current, heating of the silver sulphide element should take place in a fraction of a second after the 4000-cycle circuit has been reestablished. Filters are provided to prevent any flow of the high frequency control current in the load circuit and to prevent any flow of the low frequency load current in the control circuit.

The single figure in the accompanying drawing is a diagrammatic view of a standard frequency system constructed in accordance with the invention.

Referring to the drawing, a suitable source 1 of standard frequency current is connected by a transmission line 2 to a suitable frequency changer 3. The frequency changer 3 is preferably of the multivibrator type. The frequency of the current produced by the source 1 may be of the order of 4000 cycles and the frequency supplied by the frequency changer 3 may be of the order of 60 cycles. The output circuit 4 of the frequency changer 3 is connected to a primary winding 5 of a transformer 6. A divided secondary winding 7 of the transformer 6 is connected to a standard frequency load circuit comprising conductors 8 and 9. A resistance element 10 which has a negative temperature coefficient of resistance is connected between the divided secondary sections 7 of the transformer. The resistance element 10 is preferably composed of silver sulphide.

The silver sulphide element 10 is heated by directly impressing a high frequency current thereon. The high frequency current is obtained from the transmission conductors 2 by means of a control circuit 11. The control circuit 11 is provided with a suitable amplifier 12 which is preferably of the space discharge type. The silver sulphide element 10 is of such a size that when not heated by the high frequency current supplied by the control circuit 11, the load circuit will be blocked and prevent the flow of any 60-cycle standard current. Filters 13 and 14 comprising inductance and capacity elements are inserted in the load circuit to prevent the flow of any of the high frequency current from the control circuit through the load circuit. Filters 15 and 16 comprising inductance and capacity elements are inserted in the control circuit 11. The filters 15 and 16 offer a high impedance to 60-cycle current and serve to prevent the flow of any of the 60-cycle load current through the control circuit.

Assuming the 4000-cycle standard frequency current is supplied from the source 1 through the frequency changer 3 and the transformer 6 to the load circuit, a portion of the 4000-cycle current will be supplied through the control circuit 11 to heat the silver sulphide element 10 and permit the flow of standard 60-cycle current through the load circuit. The load circuit should become operative a fraction of a second after the 4000-cycle current from the control circuit 11 is impressed on the silver sulphide element. If the source of standard 4000-cycle current fails for any reason, the heating current supplied by the control circuit 11 will be stopped and after a predetermined interval of time the silver sulphide element 10 will be cooled sufficiently to block the

load circuit. A time lag in the cooling of the silver sulphide element insures that interruption in the high frequency current for brief intervals of time will not interrupt the flow of standard 60-cycle current through the load circuit. In case of failure of the 4000-cycle current, the multivibrator will oscillate at its own frequency which is usually only slightly different from the standard frequency supplied to the load circuit. Only a small error will be caused in the frequency of the load circuit current if the multivibrator operates for a very brief period of time without the connection of the standard 4000-cycle current thereto.

Modifications in the circuit and in the arrangement and location of parts may be made within the spirit and scope of the invention and such modifications are intended to be covered by the appended claims.

What is claimed is:

1. In combination, a load circuit having a load current impressed thereon, an element of silver sulphide having a negative temperature coefficient of resistance connected in series with said circuit for controlling the current flow therein, means for connecting a control alternating current in circuit with said element to effect heating thereof, said element of silver sulphide having a time delay in cooling to block the flow of load circuit current only a predetermined time after the control current ceases to flow, and means for preventing the load current adversely affecting the control circuit.

2. In combination, a load circuit having an alternating current impressed thereon, an element having a negative temperature coefficient of resistance connected to said circuit for controlling the current flow therein, means for connecting a control alternating current in series circuit with said element to effect heating thereof, said control current having a frequency different from the frequency of the current in said load circuit, and means for preventing flow of said control current in said load circuit around the resistance element.

3. In combination, a load circuit having an alternating current impressed thereon, an element of silver sulphide connected in series with said circuit for controlling the current flow there-through, means comprising a control circuit for connecting a control alternating current in series with said element of silver sulphide to effect heating thereof, said control alternating current having a frequency different from the frequency of the current on the load circuit, and means for preventing flow of the control current through the load circuit around said silver sulphide element and for preventing the load current adversely affecting the control circuit.

4. In combination, a circuit having a low frequency alternating current thereon, an element of silver sulphide having a negative temperature coefficient of resistance connected in series with said load circuit for controlling the current flow therein, means for heating said element by passing high frequency alternating current through it to control the current flow in said circuit, said element of silver sulphide having a time lag in cooling upon cessation of a high frequency current to prevent instantaneous stoppage of the high frequency current from blocking the load circuit, means for preventing the low frequency current adversely affecting the controlling circuit, and means for preventing the flow of high frequency current in the control circuit around said element of silver sulphide.

5. In combination, a controlled circuit having a relatively low frequency alternating current impressed thereon, an element of silver sulphide connected to said controlled circuit for blocking the current flow therein, a controlling circuit having a relatively high frequency alternating current impressed thereon and connected in series with said element of silver sulphide, said controlling circuit heating said element of silver sulphide by the high frequency current for effecting the flow of the low frequency current on the controlled circuit, means for preventing the low frequency current adversely affecting the controlling circuit, and means for preventing the flow of high frequency current in the controlled circuit around said element of silver sulphide.

6. In combination, a source of relatively high standard frequency current, means for reducing the frequency of said current to a lower frequency current and for supplying the lower frequency current to a load circuit, an element having a negative temperature coefficient of resistance connected to said load circuit for controlling the current flow therethrough, means comprising a control circuit for connecting said high frequency current in series with said element for controlling the load current flow therethrough, and means for preventing flow of the control current through the load circuit around said resistance element and for preventing flow of the load current through the control circuit.

7. In combination, a source of main standard frequency alternating current, means for deriving another standard frequency alternating current from said main frequency current and for supplying the derived frequency current to a load circuit, an element of silver sulphide in series with the load circuit for controlling the load circuit current, and means for connecting said source of main standard frequency current in series with said silver sulphide element to control the heating thereof and the flow of current through the load circuit.

8. In combination, a source of relatively high standard frequency alternating current, means for deriving a lower standard frequency current from said high frequency current and for supplying the low frequency current to a load circuit, an element having a negative temperature coefficient of resistance connected in series with said load circuit for controlling the load circuit current, means comprising a control circuit for connecting said high frequency current in series with said element to control the heating thereof and the flow of current in the load circuit, means comprising a filter for preventing flow of the high frequency current through the load circuit around said resistance element, and means comprising a filter for preventing flow of the low frequency current through the control circuit.

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